SECTION 18350
PIPE WELDING PROCEDURE SPECIFICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. WPSs for welding piping and stainless steel liner plate on-site.

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

B. Section 18100, General Welding Requirements.

C. Section 18310, General Pipe Welding Requirements.

PART 2 - PRODUCTS

2.1 MATERIAL REQUIREMENTS

A. See Section 18100, General Welding Requirements.

Part 3 - EXECUTION

3.1 PROCEDURES

A. Each piping WPS is uniquely labeled to indicate the welding process, base material(s), and weld joint type as follows:

XX-YY-N(PP)

where

XX = Welding process abbreviation
YY = Base material P-number from ASME Sect. IX
N = Sequence number
PP = Designates piping WPS

1. Welding processes:
   a. SM - Manual Shielded Metal Arc.
   b. GT - Manual Gas Tungsten Arc.
   c. GTA - Gas Tungsten Arc, Automatic.
   d. GM - Gas Metal Arc, Semi-Automatic.
   e. GMM - Gas Metal Arc, Machine.
2. Base materials:
   a. <u>Ferrous.</u>
      1) Pl - Carbon Steel.
      2) P3 - Low Alloy Steel.
      3) P4 - l/2% to 2% Cr + Mo.
      4) P5 - 2% to 10% Cr + Mo.
      5) P6 - Martensitic Stainless Steel.
      6) P7 - Ferritic Stainless Steel.
      7) P8 - Austenitic Stainless Steel.
      8) P9 - 2% through 5% Ni Steel.

9) P10- Mn-V, Cr-V, 9% Ni, Hi-Cr Alloys.
10) P11- Q + T Steel, 95 KSI min UTS.

b. Nonferrous.
1) P21 - Aluminum Alloy (to 1.2 Mn).
2) P22 - Aluminum Alloy (to 1.2 Mn, 3.5 Mg, 0.25 Cr).
3) P23 - Aluminum Alloy (to 1.0 Mg, 0.6 Si, 0.25 Cr).
4) P25 - Aluminum Alloy (to 5.l Mg, .8 Mn, .15 Cr).
5) P31 - Cu Alloys.
6) P32 - Admiralty, Naval Brass, Aluminum Brass, Muntz Metal.
7) P33 - Cu-Si Alloy.
8) P34 - Cu-Ni Alloys.
9) P35 - Aluminum Bronze Alloys.
10) P41 - Nickel.
11) P42 - Ni-Cu.
12) P43 - NiCrFe (77 Ni).
13) P44 - Ni-Mo, NiMoCr.
14) P45 - NiCrFe (33 Ni), NiFeCrMoCu.
15) HF- Hardfacing.
16) CLAD – Cladding.

NOTE: Other materials not having P-numbers may be specified by Engineering output documents. Such materials may be welded when qualified to the requirements of ASME Sect. IX.

B. Each WPS specifies all welding conditions, including base materials, current, current type, voltage, polarity, electrode size and type, filler materials, shielding gas type and flow rate, purging gas, preheat, postweld heat treatment, etc.
1. Variables not specifically addressed by the applicable WPS shall not be used.
2. All welded piping joints shall conform to Sect. 18370, Pipe Weld Joint Details (available from the Construction Manager on request), unless otherwise specified on design drawings or specifications.

C. This section contains the electronic copy of the original WPSs. The original signed copies are maintained in the Engineering Publications Office at K-1550-A.

PIPING WELDING PROCEDURES SPECIFICATION SUMMARY

WPS	BASE MATERIAL	FILLER MATERIAL	THICKNESS	COMMENTS
CARBON STEEL				
GT11-1(PP)	P-1 to P-1	F-6 (ER70S-2 or -3)	1/16 - 3/4	Purge optional
SM11-1(PP)	P-1 to P-1	F-4 (E7015, 16, or 18)	1/16 - 3/4	No open roots
SM11-2(PP)	P-1 to P-1	F-3 (E6010)	1/16 - 3/4	
STAINLESS STEEL				
GT88-1(PP)	P-8 to P-8	F-6 (300 Series)	0.035 - 3/4	Purge required
GT88-2(PP)	P-8 to P-8	Flux Coated Filler Wire	1/16 - 3/4	No purge (with restrictions)
SM88-1(PP)	P-8 to P-8	F-5 (E3XX-15 or -16)	1/16 - 3/4	
GM88-1(PP)	P-8 to P-8	F-6 (300 Series)	1/16 - 3/4	No open roots
CARBON STEEL TO STAINLESS STEEL				
GT18-2(PP)	P-1 to P-8	F-6 (ER309/309L)	1/16 - 3/4	Purge required
SM18-2(PP)	P-1 to P-8	F-5 (E309/309L-15 or 16)	1/16 - 3/4	

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **GT11-1(PP)**
ASME REVISION: 1

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): P-number 1 (Gr 1 and 2) to P-number 1 (Gr 1 and 2)
Qualified Thickness Range: 1/16 in. through 3/4 in.

IMPACTS: No

FILLER MATERIAL(S): Type: SFA5.18 F-number 6 and A-number 1
Class: ER70S-2 or ER70S-3
Deposited Thickness Range: Through 3/4 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 500EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	DCSP - No pulsing
Electrode	AWS A-5.12
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	ER70S-2 or ER70S-3
Filler mat'l diam (in.)	0.030, 0.035, 0.045, 1/16, 3/32, 1/8
Current (amps)	25-195
Arc voltage (volts)	10-23
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	See Note 2
Purging gas (cfh)	See Note 2
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: None

JOINT TYPE(S):
* Those specified in Sect. 18370 or on drawings or specifications.
* Full penetration (open butt, with backing or backgouged).
* Partial penetration, fillet, buildup, and repair.
* Nonmetallic retainers or nonfusing metal retainers (see Sect. 18310, para. 3.05 C).
* Use backing material only when specified on drawings or specifications.

POSITIONS: * All positions (vertical welding upwards).

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **GT11-1(PP)**
ASME REVISION: 1

TECHNIQUE(S):

* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18310, para. 3.07F.
* Max bead width = 4 X core diam.
* Peening - see Sect. 18310, para. 3.07G.
* Variables not listed in this WPS or Sect. 18310 are not applicable.

REFERENCES:

* Sect. 18310.
* Supporting PQR(s) - GT11-1(PP).

Notes:
1. Higher preheats (e.g., 175EF or 200EF) may (and shall be used when specified by the user organization) be utilized with this WPS.

2. Argon purge at 5 cfh min may (and shall when specified by the user organization) be used with this WPS.

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PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **SM11-1(PP)**
ASME REVISION: 1

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual SMAW-MA

BASE MATERIAL(S): P-number 1 (Gr 1, 2, and 3) to P-number 1 (Gr 1, 2, and 3)
Qualified Thickness Range: 1/16 in. through 3/4 in.

IMPACTS: No

FILLER MATERIAL(S): Type: SFA5.1 F-number 4 and A-number 1
Class: E70XX (XX - 15, 16, 18)
Deposited Thickness Range: Through 3/4 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min (see Note)
Interpass: 500EF max

WELDING CONDITIONS:

Process	SMAW	SMAW	SMAW	SMAW
Increment	All	All	All	All
Polarity	DCRP	DCRP	DCRP	DCRP
Weld filler material	E70XX	E70XX	E70XX	E70XX
Electrode diam (in.)	3/32	1/8	5/32	3/16
Current (amps)	15-115	80-145	115-205	170-275
Arc voltage (volts)	22-26	23-27	23-27	23-27

PWHT/PREHEAT MAINTENANCE: None

JOINT TYPE(S):
* Those specified in Sect. 18370 or on drawings or specifications.
* Full penetration (with backing or backgouged).
* Partial penetration, fillet, buildup, and repair.
* Nonmetallic retainers or nonfusing metal retainers (see Sect. 18310, para. 3.05 C).
* Use backing material only when specified on drawings or specifications.

POSITIONS:
* All positions (vertical welding upwards).

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **SM11-1(PP)**
ASME REVISION: 1

TECHNIQUE(S):

* Thickness of weld pass - 1/2 in. or less.
* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18310, para. 3.07F.
* Max bead width = 6 X core diam.
* Peening - see Sect. 18310, para. 3.07G.
* Variables not listed in this WPS or Sect. 18310 are not applicable.

REFERENCES:

* Sect. 18310.
* Supporting PQR(s) - SM11-1(PP).

Note: Higher preheats (e.g., 175EF) may (and shall when specified by the user organization) be utilized.

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PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **SM11-2(PP)**
ASME REVISION: 1

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual SMAW-MA

BASE MATERIAL(S): P-number 1 (Gr 1, 2, and 3) to P-number 1 (Gr 1, 2, and 3)
Qualified Thickness Range: 1/16 in. through 3/4 in.

IMPACTS: No

FILLER MATERIAL(S): Type: SFA5.1 F-number 3 and A-number N/A
Class: E6010
Deposited Thickness Range: Through 3/4 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min (see Note)
Interpass: 500EF max

WELDING CONDITIONS:

Process	SMAW	SMAW	SMAW
Increment/pass	All	All	All
Polarity	DCRP	DCRP	DCRP
Weld filler material	E6010	E6010	E6010
Electrode diam (in.)	3/32	1/8	5/32
Current (amps)	50-115	80-145	115-205
Arc voltage (volts)	22-36	22-36	23-36

PWHT/PREHEAT MAINTENANCE: None

JOINT TYPE(S):
* Those specified in Sect. 18370 or on drawings or specifications.
* Full penetration (open butt, with backing or backgouged).
* Partial penetration, fillet, buildup, and repair.
* Nonmetallic retainers or nonfusing metal retainers (see Sect. 18310, para. 3.05 C).
* Use backing material only when specified on drawings or specifications.

POSITIONS:
* All positions (vertical welding upwards).

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **SM11-2(PP)**
ASME REVISION: 1

TECHNIQUES:

* Thickness of weld pass - 1/2 in. or less.
* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18310, para. 3.07F.
* Max bead width = 6 X core diam.
* Peening - see Sect. 18310, para. 3.07G.
* Variables not listed in this WPS or Sect. 18310 are not applicable.

REFERENCES:

* Sect. 18310.
* Supporting PQR(s) - SM11-2(PP).

Note: Higher preheats (e.g., 175EF) may (and shall when specified by the user organization) be utilized.

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PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **GT88-1(PP)**
ASME REVISION: 2

DATE: January 31, 1995

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): P-number 8 (Gr 1 and 2) to P-number 8 (Gr 1 and 2)
Qualified Thickness Range: 0.035 in. through .750 in.

IMPACTS: No

FILLER MATERIAL(S): Type: SFA5.9 F-number 6 and A-number 8
Class: See Table 1 (ER3XX)
Deposited Thickness Range: Through 3/4 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	DCSP - No pulsing
Electrode	AWS A-5.12
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	See Table 1
Filler mt'l diam (in.)	0.030, 0.035, 0.045, 1/16, 3/32, 1/8
Current (amps)	15-165
Arc voltage (volts)	7-14
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	Argon
Purging gas (cfh)	5 min
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: None

JOINT TYPE(S):
* Those specified in Sect. 18370 or on drawings or specifications.
* Full penetration (open butt, with backing or backgouged).
* Partial penetration, fillet, buildup, and repair.
* Nonmetallic retainers or nonfusing metal retainers (see Sect. 18310, para. 3.05 C).
* Use backing material only when specified on drawings or specifications.

POSITIONS: * All positions (vertical welding upwards).

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **GT88-1(PP)**
ASME REVISION: 2

TECHNIQUE(S):

* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18310, para. 3.07F.
* Max bead width = 4 X core diam.
* Peening - see Sect. 18310, para. 3.07G.
* Variables not listed in this WPS or Sect. 18310 are not applicable.

REFERENCES:

* Sect. 18310.
- Supporting PQR(s) - GT88-1(PP), 302-13.

TABLE 1
Filler Metal to Use for Specified Base Metals

BASE METAL	302,304, 304H	304L	317	321,321H, 347	309	316 316H	316L	318
302, 304, 304H	ER308	ER308	ER308	ER308	ER308	ER308	ER308	ER308
304L	ER308	ER308L	ER308	ER308	ER308	ER308	ER308L ER316L	ER308
317	ER308	ER308	ER317	ER347	ER309	ER316	ER316	ER317
321, 321H, 347	ER308	ER308	ER347	ER347	ER309	ER316	ER308	ER308
309	ER308	ER308	ER309	ER309	ER309	ER316	ER308	ER309
316,316H	ER308	ER308	ER316	ER316	ER316	ER316	ER316	ER316
316L	ER308	ER308L ER316L	ER316	ER308	ER308	ER316	ER316L	ER316
318	ER308	ER308	ER317	ER318	ER309	ER316	ER316	ER318

ER308L may be substituted for ER308 if the tensile strength is 80 KSI minimum.
ER316L may be substituted for ER316 if the tensile strength is 75 KSI minimum.

Energy Systems: Original signature on file Date: 1/31/1995

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **GT88-2(PP)**
ASME REVISION: 0

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): P-number 8 to P-number 8
Qualified Thickness Range: 1/16 in. through 3/4 in.

IMPACTS: No

FILLER MATERIAL(S): Type: SFA N/A F-number N/A and A-number 8*
Class: ER308LFC (Proprietary Flux Coated Rod)
Deposited Thickness Range: Through 3/4 in., fillet unlimited
*Determined from Manufacturer's Certificate of Analysis

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	DCSP - No pulsing
Electrode	AWS A-5.12
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	ER308LFC (Flux Coated Rod by Filler Metals Inc.)
Filler mt'l diam (in.)	3/32, 1/8
Current (amps)	15-250
Arc voltage (volts)	7-17
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	None
Purging gas (cfh)	N/A
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: None

JOINT TYPE(S):
* Applicable only to open root butt welds when purging is not feasible.
* This procedure to be used only when approved in writing by a Senior Welding Inspector or Welding Technologist.

POSITIONS:
* All positions (vertical welding upwards).

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **GT88-2(PP)**
ASME REVISION: 0

TECHNIQUE(S):

* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18310, para. 3.07F.
* Max bead width = 4 X core diam.
* Peening - see Sect. 18310, para. 3.07G.
* Variables not listed in this WPS or Sect. 18310 are not applicable.

REFERENCES:

* Sect. 18310.
* Supporting PQR(s) - GT88-2(PP).

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PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **SM88-1(PP)**
ASME REVISION: 2

DATE: January 31, 1995

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual SMAW-MA

BASE MATERIAL(S): P-number 8 (Gr 1 and 2) to P-8 (Gr 1 and 2)
Qualified Thickness Range: 1/16 in. through 3/4 in.

IMPACTS: No

FILLER MATERIAL(S): Type: SFA5.4 F-number 5 and A-number 8
Class: See Table 1 (E3XX-15 or 16)
Deposited Thickness Range: Through 3/4 in., fillet unlimited.

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	SMAW	SMAW	SMAW
Increment	All	All	All
Polarity	DCRP	DCRP	DCRP
Weld filler material	See Table 1	See Table 1	See Table 1
Electrode diam (in.)	3/32	1/8	5/32
Current (amps)	50-90	70-125	100-160
Arc voltage (volts)	22-26	23-27	23-27

PWHT/PREHEAT MAINTENANCE: None

JOINT TYPE(S):
* Those specified in Sect. 18370 or on drawings or specifications.
* Full penetration (with backing or backgouged).
* Partial penetration, fillet, buildup, and repair.
* Nonmetallic retainers or nonfusing metal retainers (see Sect. 18310, para. 3.05 C).
* Use backing material only when specified on drawings or specifications.

POSITIONS:
* All positions (vertical welding upwards).

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **SM88-1(PP)**
ASME REVISION: 2

TECHNIQUES:

* Thickness of weld pass - 1/2 in. or less.
* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18310, para. 3.07F.
* Max bead width = 4 X core diam.
* Peening - see Sect. 18310, para. 3.07G.
* Variables not listed in this WPS or Sect. 18310 are not applicable.

REFERENCES:

* Sect. 18310.
* Supporting PQR(s) - SM88-1(PP).

TABLE 1
Electrodes to Use for Specified Base Metals

BASE METAL	302,304, 304H	304L	317	321,321H, 347	309	316 316H	316L	318
302,304,304H	E308	E308	E308	E308	E308	E308	E308	E308
304L	E308	E308L	E308	E308	E308	E308	E308L E316L	E308
317	E308	E308	E317	E347	E309	E316	E316	E317
321,321H,347	E308	E308	E347	E347	E309	E316	E308	E308
309	E308	E308	E309	E309	E309	E316	E308	E309
316,316H	E308	E308	E316	E316	E316	E316	E316	E316
316L	E308	E308L E316L	E316	E308	E308	E316	E316L	E316
318	E308	E308	E317	E318	E309	E316	E316	E318

E308L may be substituted for E308 if the tensile strength is 80 KSI minimum.
E316L may be substituted for E316 if the tensile strength is 75 KSI minimum.

Energy Systems: Original signature on file Date: 1/31/95

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **GM88-1(PP)**
ASME REVISION: 1

DATE: January 31, 1995

COMPANY NAME: Energy Systems

WELDING PROCESS: Semiautomatic GMAW

BASE MATERIAL(S): P-number 8 to P-8
Qualified Thickness Range: 1/16 in. through 3/4 in.

IMPACTS: No

FILLER MATERIAL(S): Type: SFA5.9 F-number 6 and A-number 8
Class: ER308L
Deposited Thickness Range: Through 3/4 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	GMAW
Increment	All
Polarity	DCRP
Transfer mode	Spray
Weld filler material	ER308L
Electrode diam (in.)	0.035, 0.045
Current (amps)	120-250
Arc voltage (volts)	23-30
Shielding gas	98% Argon-2%Oxygen
Gas flow rate	35 cfh min
Contact tube to work distance	3/4 in. max
Gas cup size	3/4 in. max
Travel speed (ipm)	7 min

PWHT/PREHEAT MAINTENANCE: None

JOINT TYPE(S):
* Those specified in Sect. 18370 or on drawings or specifications.
* Full penetration (with backing or backgouged).
* Partial penetration, fillet, build-up, and repair.
* Nonmetallic retainers or nonfusing metal retainers (see Sect. 18310, para. 3.05 C).

POSITIONS: * All positions (vertical welding upwards).

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **GM88-1(PP)**
ASME REVISION: 1

TECHNIQUE(S):

* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required. No pass may exceed 1/2 in. thickness.
* String or weave bead - see Sect. 18310, para. 3.07F.
* Max bead width = 5/8 in.
* Peening - see Sect. 18310, para. 3.07G.
* Variables not listed in this WPS or Sect. 18310 are not applicable.

REFERENCES:

* Sect. 18310.
- Supporting PQR(s) - GM88-1(PP).

TABLE 1
Filler Metal to Use for Specified Base Metals

BASE METAL	302,304, 304H	304L	317	321, 321H, 347	309	316 316H	316L	318
302, 304, 304H	ER308	ER308	ER308	ER308	ER308	ER308	ER308	ER308
304L	ER308	ER308L	ER308	ER308	ER308	ER308	ER308L ER316L	ER308
317	ER308	ER308	ER317	ER347	ER309	ER316	ER316	ER317
321, 321H, 347	ER308	ER308	ER347	ER347	ER309	ER316	ER308	ER308
309	ER308	ER308	ER309	ER309	ER309	ER316	ER308	ER309
316, 316H	ER308	ER308	ER316	ER316	ER316	ER316	ER316	ER316
316L	ER308	ER308L ER316L	ER316	ER308	ER308	ER316	ER316L	ER316
318	ER308	ER308	ER317	ER318	ER309	ER316	ER316	ER318

ER308L may be substituted for ER308 if the tensile strength is 80 KSI minimum.
ER316L may be substituted for ER316 if the tensile strength is 75 KSI minimum.

Energy Systems: Original signature on file Date: 1/31/95

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **GT18-2(PP)**
ASME REVISION: 1

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): P-number 1 to P-number 8
Qualified Thickness Range: 1/16 in. through 3/4 in.

IMPACTS: No

FILLER MATERIAL(S): Type: SFA5.9 F-number 6 and A-number 8
Class: ER309 or ER309L
Deposited Thickness Range: Through 3/4 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	DCSP - No pulsing
Electrode	AWS A-5.12
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	ER309 or ER309L
Filler mat'l diam (in.)	0.030, 0.035, 0.045, 1/16, 3/32, 1/8
Current (amps)	15-250
Arc voltage (volts)	7-17
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	Argon
Purging gas (cfh)	5 min
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: None

JOINT TYPE(S):
* Those specified in Sect. 18370 or on drawings or specifications.
* Full penetration (open butt, with backing or backgouged).
* Partial penetration, fillet, buildup, and repair.
* Nonmetallic retainers or nonfusing metal retainers (see Sect. 18310, para. 3.05 C).
* Use backing material only when specified on drawings or specifications.

POSITIONS: * All positions (vertical welding upwards).

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **GT18-2(PP)**
ASME REVISION: 1

TECHNIQUE(S):

* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18310, para. 3.07F.
* Max bead width = 4 X core diam.
* Peening - see Sect. 18310, para. 3.07G.
* Variables not listed in this WPS or Sect. 18310 are not applicable.

REFERENCES:

* Sect. 18310.
* Supporting PQR(s) - GT18-2(PP).

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PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **SM18-2(PP)**
ASME REVISION: 0

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual SMAW-MA

BASE MATERIAL(S): P-number 1 (Gr 1) to P-number 8 (Gr 1 and 2).
Qualified Thickness Range: Through 3/4 in.

IMPACTS: No

FILLER MATERIAL(S): Type: SFA5.4 F-number 5 and A-number 8
Class: E309 or E309L - 15/16
Deposited Thickness Range: Through 3/4 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	SMAW	SMAW	SMAW
Increment	All	All	All
Polarity	DCRP	DCRP	DCRP
Weld filler material	E309/309L	E309/E309L	E309/E309L
Electrode diam (in.)	3/32	1/8	5/32
Current (amps)	50-90	70-125	100-160
Arc voltage (volts)	22-26	23-27	23-27

PWHT/PREHEAT MAINTENANCE: None

JOINT TYPE(S):
* Those specified in Sect. 18370 or on drawings or specifications.
* Full penetration (with backing or backgouged).
* Partial penetration, fillet, buildup, and repair.
* Nonmetallic retainers or nonfusing metal retainers (see Sect. 8310, para. 3.05 C).
* Use backing material only when specified on drawings or specifications.

POSITIONS:
* All positions (vertical welding upwards).

PIPE WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **SM18-2(PP)**
ASME REVISION: 0

TECHNIQUES:

* Thickness of weld pass - 1/2 in. or less.
* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18310, para. 3.07F.
* Max bead width = 4 X core diam.
* Peening - see Sect. 18310, para. 3.07G.
* Variables not listed in this WPS or Sect. 18310 are not applicable.

REFERENCES:

* Sect. 18310.
* Supporting PQR(s) - SM18-2(PP).

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END OF SECTION 18350